Vortex: Configurable Open-Source RISC-V GPGPU

Cupbop: Cuda for Parallelized and Broad-range Processors

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Vortex, RISC-V GPGPU

Vortex ?

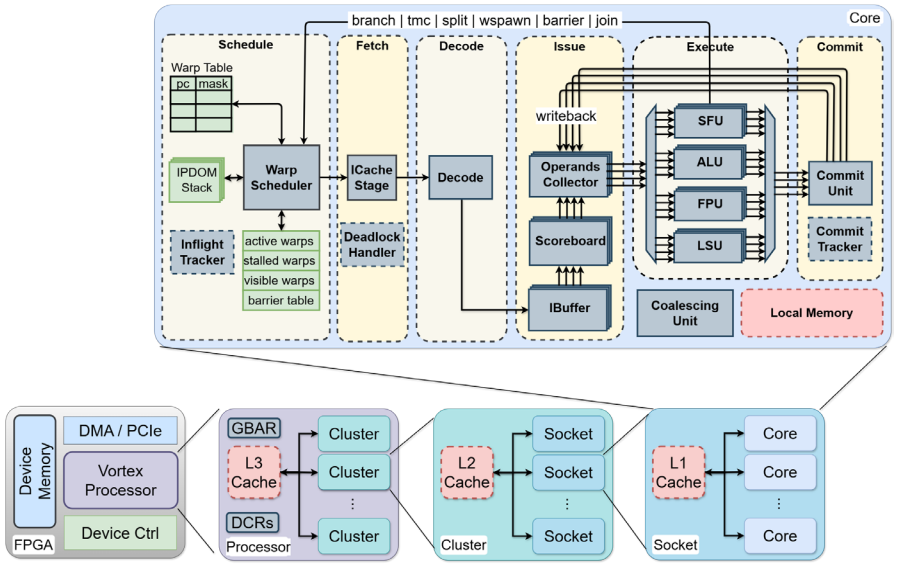
- Fully configurable multi-core SIMT GPU
- Minimal ISA extensions
- Fully Open-sourced HW/SW stack.

Vortex HW

- Synthesized on Intel/Xilinx FPGAs
  - Provides Cycle level Sim./RTL Sim./FPGA toolchain
- PCIe host-device interface
- 32 and 64bit ISA

Vortex SW stack

- Utilizing other SW stacks (LLVM, PoCL, Yosys, etc.)
- Support OpenCL (PoCL), and CUDA (CuPBoP)



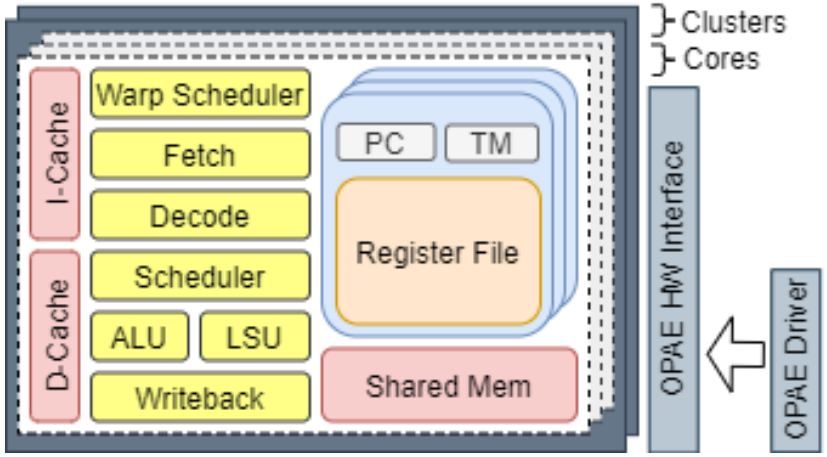
Six-stage Pipeline Vortex Microarchitecture

Vortex Software Stack

```
__kernel void foo(){
    tid = get_global_id(0);
    …
    barrier(…);
}

__host int main(){
    …
    cl_mem A_clmem = clCreateBuffer(context, …);
    clEnqueueNDRangeKernel(command_queue, foo, …);
    …
}
```

Software Support



GPU Application (OpenCL, CUDA …)

- GPU capabilities query
- Kernel and host code compilation
- GPU buffer allocation
- Kernel scheduling and execution

Vortex GPU

- CPU-GPU communication
- Kernel threads scheduling
- Kernel execution

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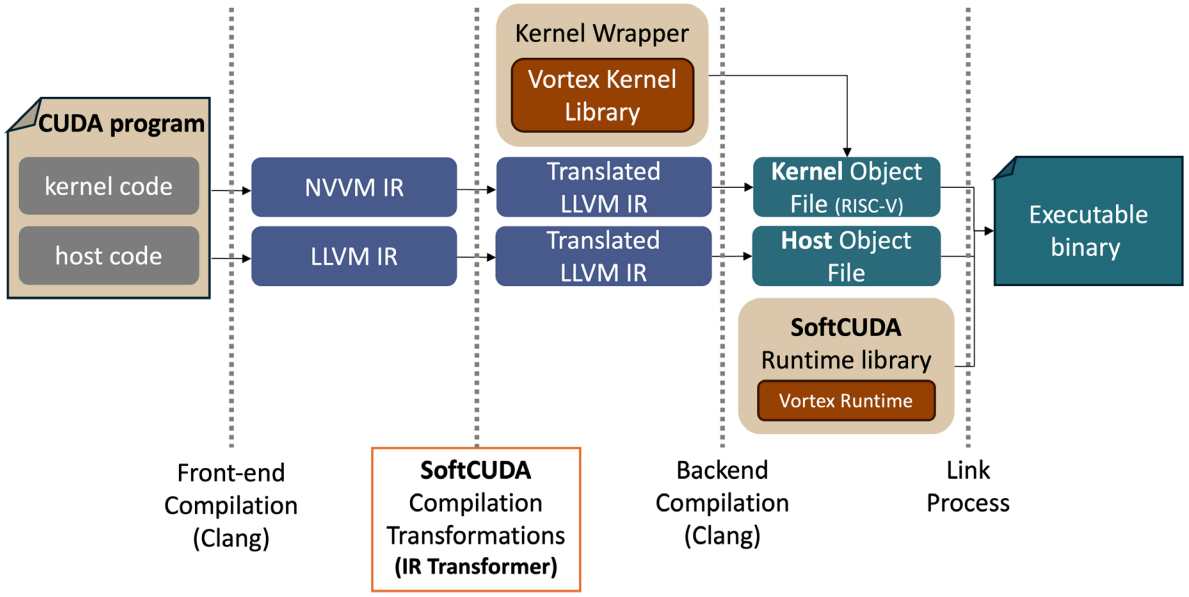
SoftCUDA: Execute CUDA on Vortex



Vortex binary generation steps using SoftCUDA

Key insights

- ***First Framework*** to support CUDA on softGPU.
- Flat-collapsing applied to map CUDA threads and Vortex HW thread.
- Kernel_wrapper for kernel invocation on Vortex using Vortex Kernel Library.

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Potential Summer Work Opportunities

- Helping to set up open source governance rules
- Helping to set up code commit procedures
- Enhancing CI/CD setups
  - Challenges are cross repositories
- Providing documentations installations/setup/testing procedures

Thank you!

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Vortex Homepage

Vortex Repo

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